

Applic. No.: 10/620,570
Amdt. Dated June 27, 2005
Reply to Office action of March 25, 2005

REMARKS/ARGUMENTS

Reconsideration of the application is requested.

Claims 1-3, 5-14, and 16-35 remain in the application. Claims 1 and 12 have been amended. Claims 4 and 15 have been cancelled.

In item 2 on page 2 of the above-mentioned Office action, claims 1-7, 11-22, 28, and 30-31 have been rejected as being anticipated by Gung (US 2002/0175074 A1) under 35 U.S.C. § 102(e).

In item 23 on page 5 of the above-mentioned Office action, claims 31-35 have been rejected as being unpatentable over Kiyota (US 5,770,025) in view of Ashitiani et al. (US 6,500,321 B1) under 35 U.S.C. § 103(a).

In item 28 on page 6 of the above-mentioned Office action, claims 32-35 have been rejected as being unpatentable over Gung in view of Ashitiani et al. under 35 U.S.C. § 103(a).

The rejections have been noted and claims 1 and 12 have been amended in an effort to even more clearly define the invention

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of the instant application. Support for the changes is found in original claims 4 and 15, respectively.

Before discussing the prior art in detail, it is believed that a brief review of the invention as claimed, would be helpful.

Claim 1 calls for, inter alia:

generating the magnetic field such that the magnetic field substantially vanishes outside the rotation axis in one of given regions and given sectors of at least one of the target region and the substrate region at least when averaged over time.

Claim 12 calls for, inter alia:

said magnetic field device generating the magnetic field such that the magnetic field substantially vanishes outside the rotation axis in at least one of the given regions and the given sectors of at least one of said target region and said substrate region at least when averaged over time.

The invention of the instant application relates to a physical vapor deposition (PVD) process with the following steps: providing a target region (30) and a substrate region (40) in a process region (50); providing an electric field (E) between the target region (30) and the substrate region (40) and thereby partially ionizing process gas constituents in the process region (40), accelerating ionized process gas constituents toward the target region (30), ejecting target constituents by using process gas constituents and partial

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depositing ejected target constituents on the substrate region (40); generating a magnetic field (B), which rotates particularly around an axis of symmetry or an axis of rotation (R) having a diameter which connects the target regions (30) and the substrate regions (40); wherein the magnetic field (B) is generated such that it substantially disappears at least in the time-average and particularly outside its rotation axis (R) in areas or sectors of the target region (30) and/or of the substrate region (40). Furthermore, the invention of the instant application also relates to a corresponding PVD device.

Gung relates to a so-called sputter magnetron and a corresponding tubular magnet as the central pole for a corresponding asymmetrical sputter magnetron. As can be seen in Figs. 1 and 3, a magnetic device 52-56 or 82-88 can each rotate around a rotation axis 58. This results in a disappearance of the magnetic field in the time-average, namely on the positions 98 and 100 as indicated in Figs. 4 and 5. However, these positions with disappearing magnetic field strength are strictly located in the area of the rotation axis and not outside it. Consequently, the desired effect in accordance with the invention of the instant application, namely symmetrizing the yield according to Figs. 3A and 3B of

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the instant application, cannot be achieved using the procedure described in Gung.

With regard to original dependent claim 4 of the instant application, the Examiner has taken the disappearance of the magnetic field outside the rotation axis 58 for granted. However, Figs 4 and 5 of Gung clearly show a strictly axial alignment of the disappearing magnetic field components in spite of the asymmetrical bearing of the magnetic devices 52-56 or 82-88.

Clearly, Gung does not show "generating the magnetic field such that the magnetic field substantially vanishes outside the rotation axis in one of given regions and given sectors of at least one of the target region and the substrate region at least when averaged over time," as recited in claim 1 and "said magnetic field device generating the magnetic field such that the magnetic field substantially vanishes outside the rotation axis in at least one of the given regions and the given sectors of at least one of said target region and said substrate region at least when averaged over time," as recited in claim 12 of the instant application.

The teachings of Kiyota and Ashitani et al. do not make up for the deficiency of Gung.

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It is true that a part of the magnetic field in the arrangements illustrated in Kiyota does disappear. However, each of these arrangements is only an isolated observation of the horizontal and vertical field components. However, the magnetic field is a vector field, and all independent vector components must disappear individually for the purpose of the complete disappearance of the magnetic field. For this purpose, the simultaneous zero-crossings in Figs 5, 6, 9 and 12 for the horizontal and vertical field components must be present at one and the same place or distance. However, none of the figures illustrates simultaneous zero-crossings for the horizontal and vertical field components. As a result, on the whole there is no disappearance of the magnetic field in the area of the target 6 in any position of the PVD units illustrated in Kiyota, thus also not outside the respective rotation axis of the magnetron.

Ashitiani et al. relate to the control of the erosion profile in case of magnetron sputters. However, Ashitiani et al. do not transcend the teachings of Gung and Kiyota, because according to the teaching of the Ashitiani et al. and especially Fig. 4 thereof, an optimization of the target takes place with respect to its shape in order to optimize the corresponding erosion on the target.

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It is accordingly believed to be clear that none of the references, whether taken alone or in any combination, either show or suggest the features of claims 1 and 12. Claims 1 and 12 are, therefore, believed to be patentable over the art and since all of the dependent claims are ultimately dependent on claims 1 or 12, they are believed to be patentable as well.

Applicants acknowledge the Examiner's statement in item 31 on page 7 of the above-mentioned Office action that claims 8-10, 23-27, and 29 would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Since claims 1 and 12 are believed to be patentable as discussed above and claims 8-10, 23-27, and 29 are ultimately dependent on claims 1 or 12, they are believed to be patentable in dependent form. A rewrite is therefore believed to be unnecessary at this time.

In view of the foregoing, reconsideration and allowance of claims 1-3, 5-14, and 16-35 are solicited.

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In the event the Examiner should still find any of the claims to be unpatentable, counsel would appreciate a telephone call so that, if possible, patentable language can be worked out.

If an extension of time for this paper is required, petition for extension is herewith made. Please charge any fees which might be due with respect to 37 CFR Sections 1.16 and 1.17 to the Deposit Account of Lerner and Greenberg, P.A., No. 12-1099.

Respectfully submitted,

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June 27, 2005

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